Recent ProMAX module upgrades

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SUMMARY

As part of the research results transmitted to sponsors every year, we release any software developed by CREWES that is deemed to be useful to sponsors for testing and using the techniques demonstrated in the research report chapters. While much of this software remains in rudimentary form, or in **MATLAB** scripts, certain key algorithms are selected for release as **ProMAX** modules, to enable application of the techniques to larger quantities of seismic data. We also attempt to maintain and upgrade **ProMAX** modules released in previous years.

In 2010, although we introduce no new modules, we have made significant modifications to three existing modules, **Gabor2**, **Gabor_sc**, and **Timath**, and we highlight those changes here.

INTO THE 64-BIT WORLD

Recently, we have begun doing more of our seismic processing on 64-bit Linux machines, as have some of our sponsors. We discovered early in 2010 that our current **ProMAX** modules would not run on these machines; so K.W. Hall determined what code changes were necessary to enable the modules to compile and run on 64-bit Linux machines. Consequently, all of the **ProMAX** modules on the CREWES website intended for Linux now have new versions which are suitable to run on either **32-bit** or **64-bit** Linux systems.

As in the past, our **ProMAX** software release consists of two files per module, one **.pdf** file containing only the module documentation, or "manual", and a **.zip** file containing not only the documentation, but all the source code needed to compile the module, as well as executables for both **32-bit** and **64-bit** systems, all in compressed format.

Figure 1 shows a portion of the **ProMAX** release table as it appears when accessed from the CREWES website. Clicking the "Manual" button retrieves the .pdf documentation for the module, while the "Module" button retrieves the .zip file containing the full download.

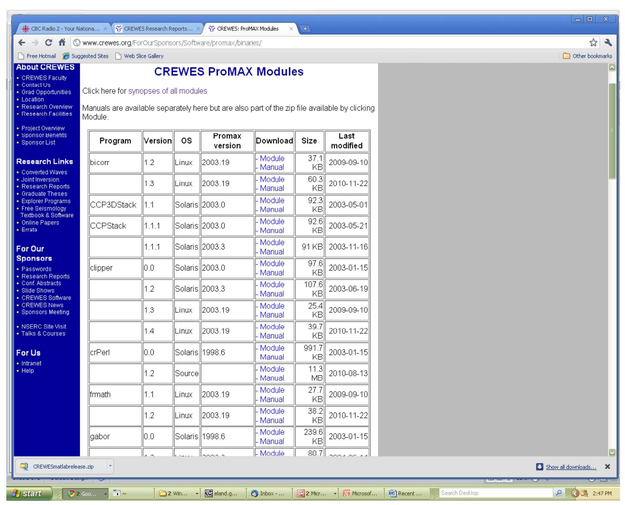


FIG. 1. Part of the table of CREWES **ProMAX** modules, available on the CREWES website. For each module, all versions currently available are listed, along with the system for which it is compiled, the version of **ProMAX** with which it is compatible, and the release date. The latest Linux release for each module includes both **32-bit** and **64-bit** executables, as well as source code that will compile and run under either system.

GABOR2 AND GABOR_SC

Both **Gabor2** and **Gabor_sc** have been modified to enable "colour-correction", whereby spectral information from a well log is used to replace the "white" reflectivity assumption conventionally used in deconvolution.

We show below Figure 2, which is a plot of the 2D colour function created from the time-varying spectral analysis of a real well log, and Figures 3 and 4, which are plots of seismic traces deconvolved **without** and **with** colour correction in **Gabor2**. (Figure 2 was made using the diagnostic feature in **Gabor_sc**, which creates output trace ensembles representing the 2D time/frequency spectrum of a raw seismic trace, the source wavelet, the Q-function, the deconvolved seismic trace, or the function used for colour correction.)

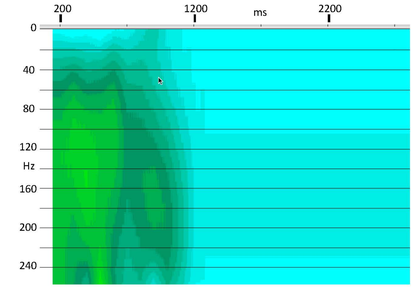


FIG. 2. This is a 2D colour function used in either **Gabor2** or **Gabor_sc** to modify the "white" spectral assumption conventionally used in deconvolution. This function was constructed within **Gabor_sc** from coefficients read from an external ASCII file created in MATLAB from spectral analysis of a well log reflectivity series. The plot was created using **Gabor_sc** in the diagnostic mode.

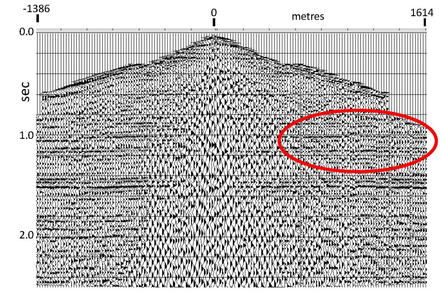


FIG. 3. This shot gather has been deconvolved using **Gabor2,** but with no colour correction. This is a standard nonstationary deconvolution result

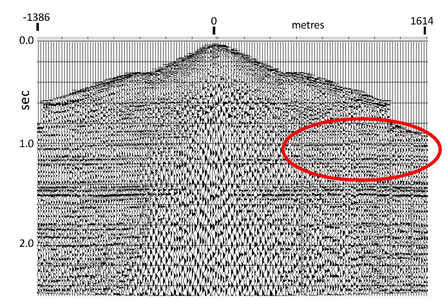
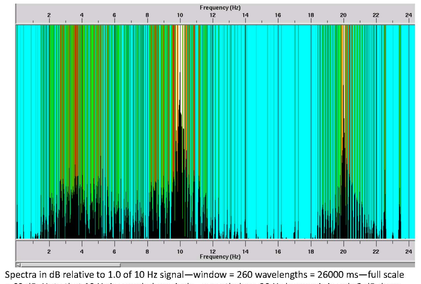


FIG. 4. This shot gather (same as Figure 3) has been deconvolved using **Gabor2**, but with colour correction using the colour function shown in Figure 2. Note bandwidth and amplitude differences between this figure and Figure 3, especially in the outlined area. Differences are subtle, but significant.

TIMATH

Timath is a toolbox module intended to help implement simple algorithms consisting of single or multi-trace operations that can be applied to one trace ensemble at a time. It consists of a **framework** to read and write trace ensembles and to pass the traces and headers to the test **algorithms**, as directed by a **function switch**. The algorithms, in sequential order inside the code, are accessed individually by selecting a unique **function number** in the **Timath** menu window. Previously implemented functions are a 2D least-squares subtraction algorithm and an envelope/picking algorithm. A new function was added this year which computes the **Discrete Fourier Transform** for a trace window of any length, to assist in detailed spectral analysis.

We show below Figure 5, which is part of a spectrum of a very long mono-frequency seismic trace, and Figures 6 and 7, which are also portions of spectra of a second mono-frequency seismic trace, which differ by only **one sample** in the length of the analysis window. ***Beware of the details in spectral analysis!***



Spectra in dB relative to 1.0 of 10 Hz signal—window = 260 wavelengths = 26000 ms—full scale = 60 dB. Note that 10 Hz is sampled precisely...nevertheless, 20 Hz harmonic is only 3 dB down.

FIG. 5. This shows the spectral detail characteristic of the **Discrete Fourier Transform** of a very long seismic trace. Since the transform is computed from its explicit trigonometric formula, any length of time series can be analyzed, not just one with the number of samples padded to a power of two, as with the FFT.

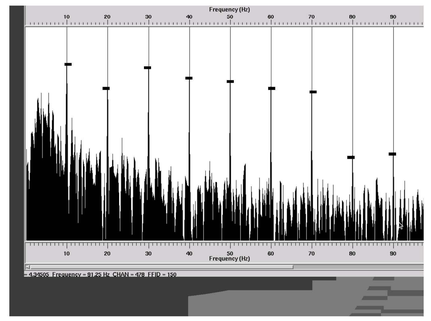


FIG. 6. This shows the DFT of 4 seconds of a long mono-frequency seismic trace. ***From the relative amplitudes of the various harmonica, the mono-frequency is not very pure!***

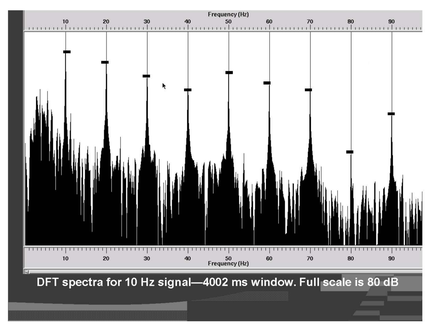


FIG. 7. This is the DFT of **the same seismic trace as in Figure 6,** but with the 4 second window extended by a single sample. Not only do the relative magnitudes of the harmonics change, but the leakage from main peaks into side-lobes increases significantly! ***Behold the perils of over-interpreting spectral analyses!***